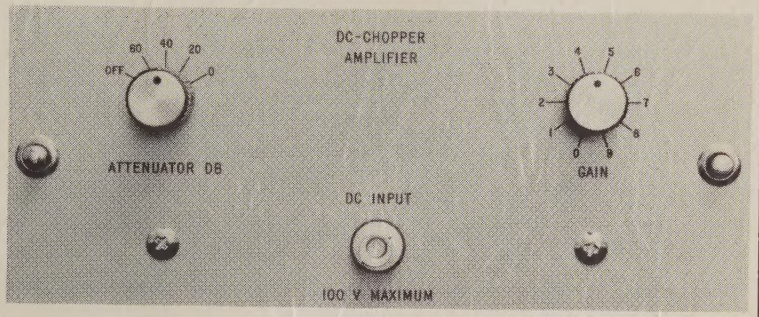
T.E.

Instruction Manual

DC Amplifier
Model 1556



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MODEL NO. 1556

SERIAL NO. 371

MODEL 1556
DC AMPLIFIER

Third Edition
May 1972

In all correspondence concerning this publication, refer to 50R006A

SCIENTIFIC-ATLANTA, INC.
P. O. Box 13654, Atlanta, Ga. 30324

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Figure 1 Model 1556 DC Amplifier

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1.1 GENERAL INFORMATION

Included in this instruction manual are installation, operation, and maintenance procedures for the Scientific-Atlanta Model 1556 DC Amplifier. Also included are a replacement parts list, and appropriate drawings and schematics.

The Model 1556 DC Amplifier is a miniature plug-in unit designed for use as a preamplifier with the Scientific-Atlanta Series 1520 Rectangular and Series 1530A Polar Pattern Recorders. The unit accepts a dc input and provides an 80-db dynamic range of recorder operation. It consists of a narrow-band amplifier preceded by a mechanical chopper. The center frequency of the narrow-band amplifier and the frequency of the chopper are both 400 cps. The unit contains a 400-cps oscillator and power amplifier which drives the mechanical chopper.

TABLE 1. TECHNICAL CHARACTERISTICS

Characteristics	Specifications
Gain (rms ac output/dc input)	18 dB (minimum)
Input Impedance	100,000 ohms
Chopper Frequency	400 Hz
Full Scale Sensitivity (With Series 1520 and 1530A Pattern Recorders)	
Linear Pen Function	0.01 volt
Square-Root Pen Function	0.1 volt
Logarithmic Pen Function	1.0 volt
DC Input Level (Maximum)	100 volts
Noise Level (rms)	10 microvolts
DC Drift (Long Term)	50 microvolts
Recorder Pen Response (3 db)	
Fixed	Three 20-dB steps

Variable	0-20 db
Attenuation Accuracy (Fixed)	±0.1 db

1.2 OPERATION

The Model 1556 DC Amplifier is directly interchangeable with the Model 1554-2 Crystal-Bolometer Amplifier normally mounted in a plug-in compartment of the Series 1520 and the Series 1530A Pattern Recorders. The 1556 permits operation of a pattern recorder from a dc signal source.

Both front and rear input connectors are provided on the preamplifier for the convenience of applying the dc input signal. The preamplifier will respond equally well to dc input signals of either polarity. The level of the dc input signal should be limited to 100 volts to remain within chopper contact current ratings.

Because the pattern recorder will respond to voltages as small as 100 microvolts, care should be taken in the construction of the input circuit and input cable when using the dc amplifier at full sensitivity. Under certain conditions, dc voltages far in excess of 100 microvolts can be generated by circuit connectors. For example, two dissimilar metals soldered together with an acid or rosin core solder have the basic characteristics of a small battery, especially when moisture is present. These effects, and thermocouple effects which also cause the generation of unwanted dc potentials, can be greatly reduced by shunting a low value of source resistance across the amplifier input.

Before recording, allow a 5-minute warm-up time for the Model 1556 DC Amplifier to ensure stability of the chopper frequency.

1.3 DETAILED DESCRIPTION

A schematic diagram of the Model 1556 DC Amplifier (Figure 1) is located at the rear of this manual. The dc input signal is connected

to the preamplifier through either the front or rear BNC connectors (A1J1 or A1J2). The SPDT chopper (A1K1) converts the dc input voltage to a 400 Hz ac voltage. this voltage is coupled through capacitor (A1C2) to the step ATTENUATOR which provides three 20-dB attenuation steps and an OFF position. The chopper is driven by a Scientific-Atlanta Model CD01-(400) Oscillator Unit. Tube A1A1V1A is a phase-shift oscillator, the frequency of which is controlled by 25-turn potentiometer A1A1R6. A clearance-hole is provided for adjustment of A1A1R6. The output of the driver stage (A1A1V1B) is transformer-coupled to the chopper. The chopper-driver plug-in package is covered by a mu-metal shield to prevent magnetic coupling into the rest of the amplifier, particularly into the 400 Hz filter (A1FL1).

The first half of A1V1 (6072) is a resistance-capacitance coupled amplifier that is driven from the output of the fixed attenuator and which drives variable GAIN control A1R10 in series with A1R12. The variable GAIN control provides a mimimum of 20 dB attenuation. The output arm of the GAIN control is connected to the input of the 400 Hz narrow-band filter (A1FL1). This filter has a 3-dB bandwidth of 35 Hz. The output circuit of the filter drives the grid of the second half of A1V1.

The second half of A1V1 is connected in cascade with the paralleled halves of A1V2. These stages comprise a feedback power amplifier which drives output transformer A1T1. The dc amplifier furnishes a nominal output of 8.5 volts (rms) when the recorder is at full scale with a logarithmic pen function.

Resistor A1R21 in series with the high-level output (pin 5) of A1T1 increases the source impedance of the amplifier to 1440 ohms to properly match the recorder logarithmic potentiometer. The low-level, low-impedance output of A1T1 (pin 7) is used when the recorder is operating with a linear or square-root pen function. Test jack A1J3 is provided at the rear of the unit to permit monitoring of the ac amplifier output.

Power is supplied through connector A1J4. The filaments of the tubes in the preamplifier are supplied with 12.6v dc to minimize 60 Hz hum. The regulated plate-supply voltage of 250 volts is connected to the amplifier stages through a series of resistance-capacitance decoupling circuits.

1.4 VISUAL INSPECTION

WARNING

HAZARDOUS VOLTAGES MAY BE EXPOSED DURING THE FOLLOWING INSPECTION PROCEDURE. PERSONNEL ARE ADVISED TO EXERCISE DUE CAUTION TO PREVENT PERSONAL INJURY.

Periodically, the instrument should be inspected as follows:

a. Disconnect all power and remove the unit from the recorder.

b. Inspect all wiring and cables for frayed, loose, or burned wires.

c. Check cable connections, making sure the plugs are free from corrosion and are properly secured.

d. Check all components for evidence of overheating, breakage, vibration damage, corrosion, or loose connections.

In the event of faulty operation of any part of the dc amplifier, a visual inspection of tubes, cable connections, and other components should be completed first. Afterward, standard maintenance procedures should be followed to isolate the trouble to a particular stage and then to the defective component. The voltage and gain tables in the following paragraphs provide a means of testing the static and dynamic circuit operation.

Table 2 provides typical values of dc voltage present at the tube socket of the amplifier stages. These voltages are measured with respect to ground using a 20,000 ohms-per-volt meter, and are subject to tolerances of ±10%. During measurement, the ATTENUATOR should be set to the OFF position.

Table 2. DC Voltages

Tube Number	Pin Numbers								
	1	2	3	4	5	6	7	8	9
A1V1	215	0	3	12.6	0	220	0	3.2	6.3
A1V2	245	5	13	12.6	0	245	5	13	6.3
A1A1V1	0	0	225	12.6	0	---	-	---	---

Table 3 shows typical values of voltage gain per stage for the dc amplifier. These measurements were made with both attenuators set to the minimum attenuation positions and with a dc voltage applied to the input.

Table 3. Voltage Gain Measurements

Gain Measured		Voltage Gain
FROM	TO	
A1J1 (dc)	Pin 7, A1V1 (peak-to-peak)	3 dB
Pin 7, A1V1	Pin 6, A1V1	9 dB
Pin 6, A1V1	Pin 2, A1V1	-1 dB
Pin 2, A1V1	Pin 2 or 7, A1V2	6 dB
Pin 2 or 7, A1V2	A1J3	12 dB

Note: The voltage measured from pin 7 to pin 1 of the 400 Hz filter (A1FL1) is 3.2 volts peak-to-peak when the amplifier output voltage at A1J3 is 8.5V (rms). This measurement should be made with an oscilloscope having an impedance of 10 megohms or higher.

1.5 CLEANING

WARNING

HAZARDOUS VOLTAGES MAY BE EXPOSED DURING THE FOLLOWING PROCEDURE. PERSONNEL ARE ADVISED TO EXERCISE DUE CAUTION TO PREVENT PERSONAL INJURY.

The following procedure should be followed when cleaning the instrument during the course of maintenance operations:

a. Disconnect all power and remove the unit from the recorder.

b. Using a clean, lint-free cloth lightly moistened with an approved cleaning solvent, remove foreign matter from the case and front panel of the instrument. Wipe dry using a clean, dry, lint-free cloth.

c. Using a hand-controlled dry-air jet (not more than 15 lbf/in^2), blow the dust from inaccessible areas. Care should be taken to prevent damage by the air blast.

d. Clean the electrical contacts of the connectors with a burnishing tool and/or cloth lightly moistened with an approved contact cleaner.

e. Clean the internal receptacles and printed circuit board contact "fingers" with a hand-controlled dry-air jet (not more than 15 lbf/in^2), and a clean, lint-free cloth lightly moistened with an approved cleaning solvent. Wipe dry with a clean, dry, lint-free cloth.

1.6 TROUBLESHOOTING

A general knowledge of the detailed description and of the front panel controls is required for efficient troubleshooting of the instrument. The following procedure is recommended for general troubleshooting.

WARNING

HAZARDOUS VOLTAGES MAY BE EXPOSED DURING THE FOLLOWING PROCEDURE. PERSONNEL ARE ADVISED TO EXERCISE DUE CAUTION TO PREVENT PERSONAL INJURY.

a. Determine that a DC amplifier trouble exists. Try to operate in the affected mode of operation. Eliminate the possibility of other equipment causing the difficulty.

b. Determine the general nature and location of the trouble by electrical tests and deductive reasoning.

c. The general circuit and its location should now be apparent. If the particular circuit is not clearly understood, refer to the circuit description in Paragraph 1.4.

d. Pinpoint the component and replace it.

e. Attempt to determine the reason the component failed. In the case of some components, the failure may be due to aging or other nonspecific fault. If possible, correct the cause of failure.

f. Apply power and observe the unit for signs of further failure.

g. Thoroughly test the unit operation associated with the repaired circuit, then return the unit to normal operation.

1.7 PARTS LIST

This section contains the replacement parts list for the DC Amplifier. When ordering parts from Scientific-Atlanta, be sure to include the equipment model number, equipment serial number, and a description of the part.

MANUFACTURERS' CODE LIST

FSCM	Manufacturer
00348	Microtran Company, Inc.
00656	Aerovox Corporation
01121	Allen-Bradley Company
02660	Amphenol Corporation
07355	Airpax Electronics, Inc.
07388	Torotel, Inc.
14655	Cornell-Dubilier Elec. Corp.
37942	Mallory P R & Co., Inc.
71590	Centralab
75042	International Resistance Co.
80183	Sprague Pots Company
80294	Bourns Laboratories, Inc.
81095	Triad Transformer Corporation
84171	Arco Electronics, Inc.

PARTS LIST ASSY DC AMPLIFIER

1556 DRAWING NO 17956

COMP DESIG	S-A PART NO	DESCRIPTION	FSCM	MFR PART NO
A01	53189	CHOPPER DRIVER ASSY CDO-400 MODEL 1556		
C01	70543	CAPACITR 800 PF 1KV CER DISC	71590	DD801
C02	70573	CAPACITR .022 MF 400V MYLAR 10%	14655	WMF4S22E
C03	70641	CAPACITR 10-10-10 MF 300V	00656	AFH3 22
C04	70641	CAPACITR 10-10-10 MF 300V	00656	AFH3 22
C05	70593	CAPACITR .1 MF 400V MYLAR 10%	14655	WMF 4P1
C06	70583	CAPACITR .05 MF 400V MET PAPER	00656	P8292Z
C07	70651	CAPACITR 25 MF 25V	80183	500D256G025CB7
FL1	71176	FILTER 400 CPS	07388	11473
J01	71063	CONN COAX BNC FEM TO CUP DBL D HOLE MT		UG-657/U
J02	71063	CONN COAX BNC FEM TO CUP DBL D HOLE MT		UG-657/U
J03	71063	CONN COAX BNC FEM TO CUP DBL D HOLE MT		UG-657/U
J04	70823	CONN RECT 14-COND FEM CHASSIS MT W/LOCK	02660	57 40140
K01	70739	CHOPPER	07355	2300 400CPS
R01	72138	RESISTOR 220K OHM 1/4W 10% COMP	01121	RCR07G224KS
R02		NOT ASSIGNED		
R03	71996	RESISTOR 3.9K OHM 1W 10% COMP	01121	RCR32G392KS
R04	72106	RESISTOR 90.9K OHM 1/4W 1% DEP CAR	91637	DC-1/4
R05	72023	RESISTOR 9.09K OHM 1/4W 1% DEP CAR	91637	DC-1/4
R06	78236	RESISTOR 909 OHM 1/4W 1% MTL FLM		RN60D9090F
R07	71893	RESISTOR 101 OHM 1/4W 1% DEP CAR	91637	DC-1/4
R08	72004	RESISTOR 4.7K OHM 1W 10% COMP	01121	RCR32G472KS
R09	72042	RESISTOR 15.0K OHM 3W 3%	91637	RS2B
R10	74573	POT 50K OHM 2W WW PRECISION 10T L.2	80294	3500S-2-503
R11	71963	RESISTOR 1.2K OHM 3W	24681	VAL3
R12	71966	RESISTOR 1.5K OHM 1/4W 10% COMP	01121	RCR07G152KS
R13	72165	RESISTOR 470K OHM 1/4W 10% COMP	01121	RCR07G474KS
R14	71963	RESISTOR 1.2K OHM 3W	24681	VAL3
R15	75698	RESISTOR 100K OHM 1/2W 10% COMP	01121	RCR20G104KS
R16		NOT ASSIGNED		
R17		NOT ASSIGNED		
R18	72042	RESISTOR 15.0K OHM 3W 3%	91637	RS2B

PARTS LIST ASSY DC AMPLIFIER

1556 DRAWING NO 17956

COMP DESIG	S-A PART NO	DESCRIPTION	FSCM	MFR PART NO
R19	71979	RESISTOR 2.2K OHM 1W 10% COMP	01121	RCR32G222KS
R20*		FACTORY SELECTED VALUE		
R21	74702	RESISTOR 1.0K OHM 1/4W 5% COMP	01121	RCR07G102JS
R22	71974	RESISTOR 1.8K OHM 1/2W 10% COMP	01121	RCR20G182KS
R23	71814	RESISTOR 1 OHM 2W	75042	BWH
R24	72219	RESISTOR 8.2 MEG 1/2W 10% COMP	01121	RCR20G825KS
S01	72939	SWITCH ROT 2P 2-6 POS SH 1 SEC	71590	PA-2002
T01	73100	XFMR PRI 15K 3MADC SEC 600/250/50	81095	J0-22
V01	75927	TUBE ELE 6189 GB		
V02	73173	TUBE ELE 12AY7 ELECTRON		
TYP*	72148	RESISTOR 270K OHM 1/2W 10% COMP	01121	RCR20G274KS

PARTS LIST ASSY CHOPPER DRIVER

1556 DRAWING NO 17956 REF DESIG PREFIX A1

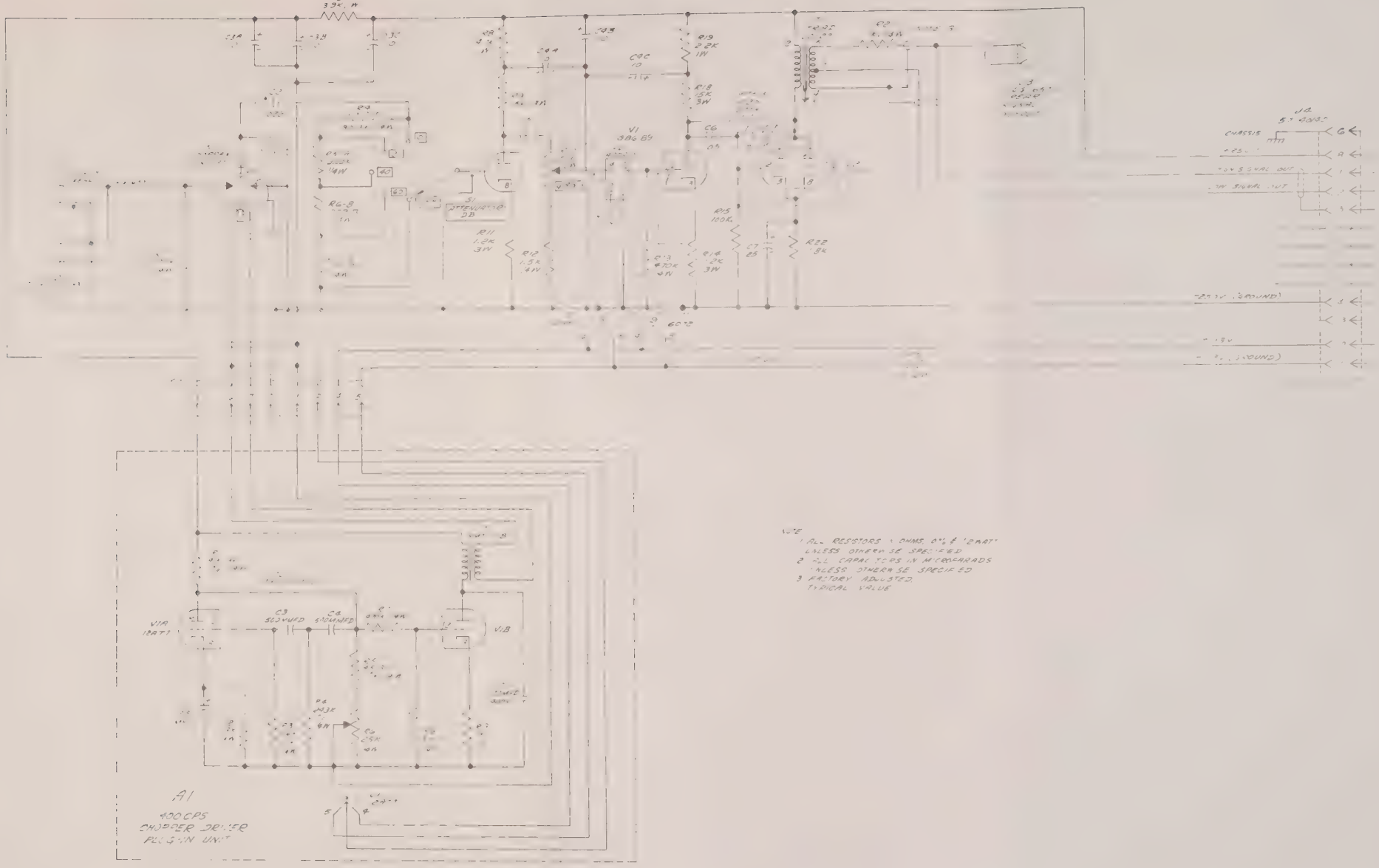
COMP DESIG	S-A PART NO	DESCRIPTION	FSCM	MFR PART NO
C01	70651	CAPACITR 25 MF 25V	80183	500D256G025CB7
C02	78818	CAPACITR 390 PF 500V SILVER MICA 1%	84171	DM-15-391F
C03	70541	CAPACITR 500 PF 1KV CER DISC	71590	DD 501
C04	70541	CAPACITR 500 PF 1KV CER DISC	71590	DD 501
C05	70573	CAPACITR .022 MF 400V MYLAR 10%	14655	WME4S22E
R01	72082	RESISTOR 49.9K OHM 1/4W 1% DEP CAR	91637	DC-1/4
R02	71973	RESISTOR 1.8K OHM 1/4W 10% COMP	01121	RCR07G182KS
R03	77166	RESISTOR 316 OHM 1/4W 1% DEP CAR	91637	DC-1/4
R04	77625	RESISTOR 243K OHM 1/4W 1% MTL FLM		RN65C2433F
R05	77076	MARKER WIRE 37 VINYL 3/4 IN LG	85480	B-700
R06	71715	POT 25K OHM 1/2W WW 25T SCRW MT SLDR LUG	80294	2C0S-1-253
R07	72165	RESISTOR 470K OHM 1/4W 10% COMP	01121	RCR07G474KS
R08	72159	RESISTOR 390K OHM 1/4W 10% COMP	01121	RCR07G394KS
R09	71951	RESISTOR 1.0K OHM 1/4W 10% COMP	01121	RCR07G102KS
T01	73102	XFMR PRI 10KCT 6MADC SEC 200CT	00348	MMT17-FB
T01	73102	XFMR PRI 10KCT 6MADC SEC 200CT	00348	MMT17-FB
V01	73170	TUBE ELE 12AT7 ELECTRON		

PARTS LIST ABBREVIATIONS

Abbreviation	Word
A	Ampere
AC	Alternating current
ACT	Action, acting
AFC	Automatic frequency control
AGC	Automatic gain control
AMP, AMPL	Amplifier
ANGL	Angle
APC	Automatic phase control
ASSY	Assembly
BCD	Binary-coded-decimal
CAP	Capacitance, capacitor
CAR	Carbon
CBL	Cable
CCW	Counterclockwise
CDX	Control differential transformer
CER	Ceramic
CHS	Chassis
COAX	Coaxial
COMP	Component, composition
COND	Conductor
CONN	Connector
CONT	Contact(s)
CPS	See Hertz
CRT	Cathode-ray tube
CT	Control transformer, center-tapped
CTR	Center
CW	Continuous-wave, counterclockwise
ELECT	Electrolytic, electric(al), electron(ic)
ENCAP	Encapsulated
FEM	Female
FET	Field-effect transistor
FLM	Film
FTHRU	Feedthrough
FUS	Fuse(d)
GER	Germanium
GHZ	Gigahertz
GND	Ground
H, HY	Henry
HD	Head
HEX	Six-sided
HLDR	Holder
()-IN	()-Input(s)
IC, INT CKT	Integrated circuit
IF	Intermediate frequency
IN	Input
INC	Incandenscent
INTL	Internal
JUNC	Junction
K	Kilo
LATCH	Latch(ing)
LCK	Lock, locking
M	Milli
MA	Milliampere
MAX	Maximum
MDM	Medium
MEG	Million (ohms)
MET	Metal
MF	Microfarad
MHZ	Megahertz
MIN	Minimum
MOD	Model, modular
MOLD	Molded
MOM	Momentary
MOS	Metal-oxide semi-conductor
MOT	Motor
MT, MTG	Mount, mounting
MTL	See MET
MW	Milliwatt
MYL	Mylar

PARTS LIST ABBREVIATIONS

Abbreviation	Word
NC	Normally closed
NI	Nickel
NO	Normally open
NP	Nonpolarized
NSH	Non-shorting
OP	Operating, operational
OSC	Oscillate(ing)(or) oscilloscope
PC	Piece
PAP	Paper
PC	Printed circuit
POLYCB	Polycarbonate
PF	Picofarad
PIV	Peak inverse voltage
PL	Plated
PNL	Panel
POL	Polar(ized)
POS	Position
POT	Potentiometer
PRI	Primary
PROT	Protect(or)(ion)
PS	Polystyrene
PUSH	Pushbutton
PWR	Power
RCVG	Receiving
RCVR	Receiver
RECPT	Receptacle
RECT	Rectifier, rectangular
REG	Regulate(d)(ing)(or)
RES	Resist(ance)(or)
RF	Radio Frequency
RND	Round
ROT	Rotary
RT	Right
SE	Slow acting, slow blow
SCR	Silicon controlled rectifier
SCS	Silicon-controlled switch
SEC	Second(ary)(s)
SEL	Select(ed)(or)
SEP	Separate
SH	Shorting
SHFT	Shaft
SHLD	Shield(ed)(ing)
SI	See SIL
SIG	Signal
SIL	Silicon
SPDT	Single-pole, double-throw
SPST	Single-pole, single-throw
SQ	Square
SUBMIN	Subminiature
SUP	Supply, suppressor
SW	Switch
T	Turn
TACH	Tachometer
TANT	Tanalum
TC	Temperature-compensat(ion)ted,
TERM	Terminal(s)
TNL	Tunnel
TOG	Toggle
TTL	Transistor-transistor logic
U	Micro
UA	Micro ampere
UH	Microhenry
UHF	Ultra high frequency
UJT	Unijunction transistor
V	Volt(s)(age)
VAL	Value(s)
VAR	Variable
W	Watt
W/	With
W/O	Without
WW	Wirewound
XFMR	Transformer
XTAL	Crystal
XMTR	Transmitter
ZEN	Zener



NOTE
1 ALL RESISTORS : OHMS 0% & 2 WATT UNLESS OTHERWISE SPECIFIED
2 ALL CAPACITORS IN MICROFARADS UNLESS OTHERWISE SPECIFIED
3 FACTORY ADJUSTED TYPICAL VALUE

CONVERSION OF VOLTAGE AND POWER RATIOS TO DECIBELS

The basic chart below indicates the number of decibels (dB) corresponding to the listed ratios of voltage or power over the range of −20 to +20 dB. For voltage or power ratios greater than those included in the chart, the ratio can be broken down into a product of two numbers, the value in dB for each found separately, and the two results added. Example: To convert a power ratio of 2,000:1 to dB, express 2,000 as 2×10^3; the number of dB corresponding to a power ratio of 2 is very nearly 3, and the number of dB for a power ratio of 10^3 is 30. Therefore, the power ratio of 2,000:1 is approximately 30 dB + 3 dB = 33 dB. In the lower righthand corner of the chart dB values for voltage and power ratios of integral powers of 10 are given.

Voltage Ratio	*Power Ratio*	*−dB+*	*Voltage Ratio*	*Power Ratio*	*Voltage Ratio*	*Power Ratio*	*−dB+*	*Voltage Ratio*	*Power Ratio*	*Voltage Ratio*	*Power Ratio*	*−dB+*	*Voltage Ratio*	*Power Ratio*
1.000	**1.000**	**0**	**1.000**	**1.000**	**.447**	**.200**	**7.0**	**2.239**	**5.012**	**.200**	**.0398**	**14.0**	**5.012**	**25.12**
.989	.977	.1	1.012	1.023	.442	.195	7.1	2.265	5.129	.197	.0389	14.1	5.070	25.70
.977	.955	.2	1.023	1.047	.437	.191	7.2	2.291	5.248	.195	.0380	14.2	5.129	26.30
.966	.933	.3	1.035	1.072	.432	.186	7.3	2.317	5.370	.193	.0372	14.3	5.188	26.92
.955	.912	.4	1.047	1.096	.427	.182	7.4	2.344	5.495	.191	.0363	14.4	5.248	27.54
.944	.891	.5	1.059	1.122	.422	.178	7.5	2.371	5.623	.188	.0355	14.5	5.309	28.18
.933	.871	.6	1.072	1.148	.417	.174	7.6	2.399	5.754	.186	.0347	14.6	5.370	28.84
.923	.851	.7	1.084	1.175	.412	.170	7.7	2.427	5.888	.184	.0339	14.7	5.433	29.51
.912	.832	.8	1.096	1.202	.407	.166	7.8	2.455	6.026	.182	.0331	14.8	5.495	30.20
.902	.813	.9	1.109	1.230	.403	.162	7.9	2.483	6.166	.180	.0324	14.9	5.559	30.90
.891	**.794**	**1.0**	**1.122**	**1.259**	**.398**	**.159**	**8.0**	**2.512**	**6.310**	**.178**	**.0316**	**15.0**	**5.623**	**31.62**
.881	.776	1.1	1.135	1.288	.394	.155	8.1	2.541	6.457	.176	.0309	15.1	5.689	32.36
.871	.759	1.2	1.148	1.318	.389	.151	8.2	2.570	6.607	.174	.0302	15.2	5.754	33.11
.861	.741	1.3	1.161	1.349	.385	.148	8.3	2.600	6.761	.172	.0295	15.3	5.821	33.88
.851	.724	1.4	1.175	1.380	.380	.145	8.4	2.630	6.918	.170	.0288	15.4	5.888	34.67
.841	.708	1.5	1.189	1.413	.376	.141	8.5	2.661	7.079	.168	.0282	15.5	5.957	35.48
.832	.692	1.6	1.202	1.445	.372	.138	8.6	2.692	7.244	.166	.0275	15.6	6.026	36.31
.822	.676	1.7	1.216	1.479	.367	.135	8.7	2.723	7.413	.164	.0269	15.7	6.095	37.15
.813	.661	1.8	1.230	1.514	.363	.132	8.8	2.754	7.586	.162	.0263	15.8	6.166	38.02
.804	.646	1.9	1.245	1.549	.359	.129	8.9	2.786	7.762	.160	.0257	15.9	6.237	38.90
.794	**.631**	**2.0**	**1.259**	**1.585**	**.355**	**.126**	**9.0**	**2.818**	**7.943**	**.159**	**.0251**	**16.0**	**6.310**	**39.81**
.785	.617	2.1	1.274	1.622	.351	.123	9.1	2.851	8.128	.157	.0246	16.1	6.383	40.74
.776	.603	2.2	1.288	1.660	.347	.120	9.2	2.884	8.318	.155	.0240	16.2	6.457	41.69
.767	.589	2.3	1.303	1.698	.343	.118	9.3	2.917	8.511	.153	.0234	16.3	6.531	42.66
.759	.575	2.4	1.318	1.738	.339	.115	9.4	2.951	8.710	.151	.0229	16.4	6.607	43.65
.750	.562	2.5	1.334	1.778	.335	.112	9.5	2.985	8.913	.150	.0224	16.5	6.683	44.67
.741	.550	2.6	1.349	1.820	.331	.110	9.6	3.020	9.120	.148	.0219	16.6	6.761	45.71
.733	.537	2.7	1.365	1.862	.327	.107	9.7	3.055	9.333	.146	.0214	16.7	6.839	46.77
.724	.525	2.8	1.380	1.905	.324	.105	9.8	3.090	9.550	.145	.0209	16.8	6.918	47.86
.716	.513	2.9	1.396	1.950	.320	.102	9.9	3.126	9.772	.143	.0204	16.9	6.998	48.98
.708	**.501**	**3.0**	**1.413**	**1.995**	**.316**	**.100**	**10.0**	**3.162**	**10.000**	**.141**	**.0200**	**17.0**	**7.079**	**50.12**
.700	.490	3.1	1.429	2.042	.313	.0977	10.1	3.199	10.23	.140	.0195	17.1	7.161	51.29
.692	.479	3.2	1.445	2.089	.309	.0955	10.2	3.236	10.47	.138	.0191	17.2	7.244	52.48
.684	.468	3.3	1.462	2.138	.306	.0933	10.3	3.273	10.72	.137	.0186	17.3	7.328	53.70
.676	.457	3.4	1.479	2.188	.302	.0912	10.4	3.311	10.96	.135	.0182	17.4	7.413	54.95
.668	.447	3.5	1.496	2.239	.299	.0891	10.5	3.350	11.22	.133	.0178	17.5	7.499	56.23
.661	.437	3.6	1.514	2.291	.295	.0871	10.6	3.388	11.48	.132	.0174	17.6	7.586	57.54
.653	.427	3.7	1.531	2.344	.292	.0851	10.7	3.428	11.75	.130	.0170	17.7	7.674	58.88
.646	.417	3.8	1.549	2.399	.288	.0832	10.8	3.467	12.02	.129	.0166	17.8	7.762	60.26
.638	.407	3.9	1.567	2.455	.285	.0813	10.9	3.508	12.30	.127	.0162	17.9	7.852	61.66
.631	**.398**	**4.0**	**1.585**	**2.512**	**.282**	**.0794**	**11.0**	**3.548**	**12.59**	**.126**	**.0159**	**18.0**	**7.943**	**63.10**
.624	.389	4.1	1.603	2.570	.279	.0776	11.1	3.589	12.88	.125	.0155	18.1	8.035	64.57
.617	.380	4.2	1.622	2.630	.275	.0759	11.2	3.631	13.18	.123	.0151	18.2	8.128	66.07
.610	.372	4.3	1.641	2.692	.272	.0741	11.3	3.673	13.49	.122	.0148	18.3	8.222	67.61
.603	.363	4.4	1.660	2.754	.269	.0724	11.4	3.715	13.80	.120	.0145	18.4	8.318	69.18
.596	.355	4.5	1.679	2.818	.266	.0708	11.5	3.758	14.13	.119	.0141	18.5	8.414	70.79
.589	.347	4.6	1.698	2.884	.263	.0692	11.6	3.802	14.45	.118	.0138	18.6	8.511	72.44
.582	.339	4.7	1.718	2.951	.260	.0676	11.7	3.846	14.79	.116	.0135	18.7	8.610	74.13
.575	.331	4.8	1.738	3.020	.257	.0661	11.8	3.890	15.14	.115	.0132	18.8	8.710	75.86
.569	.324	4.9	1.758	3.090	.254	.0646	11.9	3.936	15.49	.114	.0129	18.9	8.811	77.62
.562	**.316**	**5.0**	**1.778**	**3.162**	**.251**	**.0631**	**12.0**	**3.981**	**15.85**	**.112**	**.0126**	**19.0**	**8.913**	**79.43**
.556	.309	5.1	1.799	3.236	.248	.0617	12.1	4.027	16.22	.111	.0123	19.1	9.016	81.28
.550	.302	5.2	1.820	3.311	.246	.0603	12.2	4.074	16.60	.110	.0120	19.2	9.120	83.18
.543	.295	5.3	1.841	3.388	.243	.0589	12.3	4.121	16.98	.108	.0118	19.3	9.226	85.11
.537	.288	5.4	1.862	3.467	.240	.0575	12.4	4.169	17.38	.107	.0115	19.4	9.333	87.10
.531	.282	5.5	1.884	3.548	.237	.0562	12.5	4.217	17.78	.106	.0112	19.5	9.441	89.13
.525	.275	5.6	1.905	3.631	.234	.0550	12.6	4.266	18.20	.105	.0110	19.6	9.550	91.20
.519	.269	5.7	1.928	3.715	.232	.0537	12.7	4.315	18.62	.104	.0107	19.7	9.661	93.33
.513	.263	5.8	1.950	3.802	.229	.0525	12.8	4.365	19.05	.102	.0105	19.8	9.772	95.50
.507	.257	5.9	1.972	3.890	.227	.0513	12.9	4.416	19.50	.101	.0102	19.9	9.886	97.72
.501	**.251**	**6.0**	**1.995**	**3.981**	**.224**	**.0501**	**13.0**	**4.467**	**19.95**	**.100**	**.0100**	**20.0**	**10.000**	**100.00**
.496	.246	6.1	2.018	4.074	.221	.0490	13.1	4.519	20.42					
.490	.240	6.2	2.042	4.169	.219	.0479	13.2	4.571	20.89		10^{-3}	30		10^{3}
.484	.234	6.3	2.065	4.266	.216	.0468	13.3	4.624	21.38	10^{-2}	10^{-4}	40	10^{2}	10^{4}
.479	.229	6.4	2.089	4.365	.214	.0457	13.4	4.677	21.88					
											10^{-5}	50		10^{5}
.473	.224	6.5	2.113	4.467	.211	.0447	13.5	4.732	22.39	10^{-3}	10^{-6}	60	10^{3}	10^{6}
.468	.219	6.6	2.138	4.571	.209	.0437	13.6	4.786	22.91		10^{-7}	70		10^{7}
.462	.214	6.7	2.163	4.677	.207	.0427	13.7	4.842	23.44	10^{-4}	10^{-8}	80	10^{4}	10^{8}
.457	.209	6.8	2.188	4.786	.204	.0417	13.8	4.898	23.99		10^{-9}	90		10^{9}
.452	.204	6.9	2.213	4.898	.202	.0407	13.9	4.955	24.55					
										10^{-5}	10^{-10}	100	10^{5}	10^{10}
											10^{-11}	110		10^{11}
										10^{-6}	10^{-12}	120	10^{6}	10^{12}

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